

A JOURNAL OF  
APPLIED NUCLEAR  
SCIENCES, NUCLEAR  
ENGINEERING, AND  
RELATED TECHNOLOGY



175  
**nuclear**  
**technology**

ROY G. POST, *Editor*

VOLUME 14

April 1972 through June 1972

**AMERICAN NUCLEAR SOCIETY**

244 EAST OGDEN AVENUE  
HINSDALE, ILLINOIS 60521 USA

Copyright © 1972, by American Nuclear Society, Inc., Hinsdale, Illinois 60521

# CONTENTS OF VOLUME 14

## TECHNICAL PAPERS AND NOTES

VOLUME 14, NO. 1 APRIL 1972 / PAGES 1-110

### Session on PHYSICS OF NUCLEAR MATERIALS SAFEGUARDS

#### TECHNICAL PAPERS

##### REACTORS

|                                                                                                                                                     |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Preface / <i>Tsahi Gozani</i> - - - - -                                                                                                             | 6  |
| Physics of Nuclear Materials Safeguards Techniques /<br><i>Tsahi Gozani</i> - - - - -                                                               | 8  |
| Near Barrier Fission Induced with Photons / <i>John R.<br/>Huizenga</i> - - - - -                                                                   | 20 |
| Low Energy Photofission of Heavy Elements—Experimental<br>Results / <i>R. L. Bramblett, T. Gozani, R. O. Ginaven, D. E.<br/>Rundquist</i> - - - - - | 33 |
| Theory of Delayed-Neutron Physics / <i>L. Tomlinson</i> - - -                                                                                       | 42 |
| Physics of Delayed Neutrons—Recent Experimental Re-<br>sults / <i>G. Robert Keepin</i> - - - - -                                                    | 53 |
| Application of Neutron Techniques in the Nondestructive<br>Assay of Fissile Materials / <i>D. Stegemann</i> - - - - -                               | 59 |

##### FUELS

|                                                                                                           |    |
|-----------------------------------------------------------------------------------------------------------|----|
| A Model for the High Temperature Swelling of Clad Oxide<br>Fuel / <i>Arthur A. Bauer</i> - - - - -        | 65 |
| Some Effects of Water Sprinklers on Array Criticality<br>Safety Analyses / <i>G. R. Handley</i> - - - - - | 71 |

##### RADIOACTIVE WASTE

|                                                                                                                                                       |    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <i>In Situ</i> Incorporation of Nuclear Waste in Deep Molten<br>Silicate Rock / <i>Jerry J. Cohen, Arthur E. Lewis, Robert L.<br/>Braun</i> - - - - - | 76 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|----|

##### RADIOISOTOPES

|                                                                                                                                             |    |
|---------------------------------------------------------------------------------------------------------------------------------------------|----|
| The Atomic Energy Research Establishment Miniature<br>Nuclear Battery / <i>A. W. Penn, M. H. Brown, J. Myatt,<br/>M. J. Poole</i> - - - - - | 89 |
|---------------------------------------------------------------------------------------------------------------------------------------------|----|

##### ANALYSIS

|                                                                                                       |    |
|-------------------------------------------------------------------------------------------------------|----|
| Copper Assay of Biomaterials with Neutron Activation / <i>N.<br/>Spronk, R. J. van Hoek</i> - - - - - | 96 |
|-------------------------------------------------------------------------------------------------------|----|

##### MATERIALS

|                                                                                                                                                                                 |     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Precision and Source of Variation of Oxygen-to-Metal De-<br>termination for (U,Pu)O <sub>2</sub> / <i>W. J. Lackey, R. A. Bradley,<br/>W. H. Pechin, T. L. Hebble</i> - - - - - | 105 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|

|                                                                                                                                                                                  |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| First Loss of Flow Experiment with an FTR-Type Fuel Pin<br>in the Mark-II Loop / <i>J. C. Carter, R. T. Purviance, J. F.<br/>Boland, C. E. Dickerman, J. E. Hanson</i> - - - - - | 133 |
| Fuel Rod Enrichment Determination by Gamma-Ray Spec-<br>trometry / <i>A. D. Vaughn, R. I. Smith</i> - - - - -                                                                    | 146 |
| A Simple Method of Calculating the Radial Temperature<br>Distribution in a Mixed-Oxide Fuel Element / <i>R. O. Meyer,<br/>B. J. Buescher</i> - - - - -                           | 153 |

##### RADIOACTIVE WASTE

|                                                                                             |     |
|---------------------------------------------------------------------------------------------|-----|
| Radioactive Waste Management and Radiation Exposure /<br><i>Morton I. Goldman</i> - - - - - | 157 |
|---------------------------------------------------------------------------------------------|-----|

##### MATERIALS

|                                                                                                                                                                      |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| The Effect of Stress Ratio on the Elevated Temperature<br>Fatigue-Crack Propagation of Type 304 Stainless Steel /<br><i>Lee A. James</i> - - - - -                   | 163 |
| In-Pile Dimensional Changes in Zircaloy-4 Tubing Having<br>Low Hoop Stresses (Light Water Breeder Reactor Develop-<br>ment Program) / <i>Ray C. Daniel</i> - - - - - | 171 |

##### NUCLEAR EXPLOSIVES

|                                                                                            |     |
|--------------------------------------------------------------------------------------------|-----|
| Project Rulison—Summary of Results and Analyses / <i>Miles<br/>Reynolds, Jr.</i> - - - - - | 187 |
|--------------------------------------------------------------------------------------------|-----|

#### TECHNICAL NOTES

##### INSTRUMENTS

|                                                                                                                           |     |
|---------------------------------------------------------------------------------------------------------------------------|-----|
| Note on Detectability Enhancement on Weak Neutron Burst<br>Signals Through Multiplication / <i>K. G. Porges</i> - - - - - | 194 |
|---------------------------------------------------------------------------------------------------------------------------|-----|

##### ANALYSIS

|                                                                                                                                                                                     |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Measurement of the Uranium-235 Content in a Spent MTR<br>Type Fuel Element Using the Delayed-Neutron Yield Tech-<br>nique / <i>R. H. Augustson, C. N. Henry, C. R. Weisbin-</i> - - | 197 |
| Vector Analysis of Time-Dependent Gamma-Ray Spectra /<br><i>W. L. Filippone, F. J. Munro</i> - - - - -                                                                              | 200 |

VOLUME 14, NO. 3 JUNE 1972 / PAGES 203-302

#### TECHNICAL PAPERS

##### REACTORS

|                                                                                                                                                          |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| The Use of Signal Coherence for Anomaly Detection in Nu-<br>clear Reactors / <i>Robert W. Albrecht</i> - - - - -                                         | 208 |
| Steam Generator Vessel Pressures Resulting from a<br>Sodium-Water Reaction—A Computer Analysis with the<br>SWEAR Code / <i>David A. Greene</i> - - - - - | 218 |

##### REACTOR SITING

|                                                                                                                                                                                                               |     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| New Perspectives on Low Level Environmental Radiation<br>Monitoring Around Nuclear Facilities / <i>H. L. Beck, J. A.<br/>DeCampo, C. V. Gogolak, W. M. Lowder, J. E. McLaughlin,<br/>P. D. Raft</i> - - - - - | 232 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|

##### FUELS

|                                                                                                                                                          |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| The Effects of Transverse Flow Through Graphite on<br>Fission Product Movement in HTGR-Type Systems / <i>M. N.<br/>Özişik, M. D. Silverman</i> - - - - - | 240 |
| An Analytical Method for Calculating Steady-State Fission<br>Gas Release / <i>V. F. Baston, J. H. McFadden, W. A. Yuill</i> -                            | 247 |

VOLUME 14, NO. 2 MAY 1972 / PAGES 111-202

#### TECHNICAL PAPERS

##### FUEL CYCLES

|                                                                                                                     |     |
|---------------------------------------------------------------------------------------------------------------------|-----|
| Optimal Operational Strategy in Nuclear Fuel Management /<br><i>P. Civita, P. Fornaciari, T. Mazzanti</i> - - - - - | 116 |
| Pressurized Water Reactor Optimal Fuel Management /<br><i>Barry N. Naft, Alexander Sesonske</i> - - - - -           | 123 |

# CONTENTS OF VOLUME 14

## TECHNICAL PAPERS AND NOTES

Microstructure of Sol-Gel-Derived (U,Pu)O<sub>2</sub> Microspheres  
and Pellets / *W. J. Lackey, R. A. Bradley* - - - - - 257

### RADIOISOTOPES

Electronic Assay of Californium-252 Neutron Sources /  
*T. R. Herold* - - - - - 269

### INSTRUMENTS

Thermal-Neutron Radiography with a Sealed-Tube Neutron  
Generator and Water Moderator / *Dennis G. Vasiluk,*  
*Richard L. Murri, George P. Fisher* - - - - - 279

Measurement of Fast- and Thermal-Neutron Fluxes Using  
a Small LiI(Eu) Crystal Detector / *Dong H. Nguyen, Robert*  
*G. Bennett* - - - - - 284

### TECHNICAL NOTE

### MATERIALS

An Empirical Representation of Irradiation-Induced Swell-  
ing of Solution Treated Type 304 Stainless Steel / *J. F.*  
*Bates, J. L. Straalsund* - - - - - 292

## DEPARTMENTS

|                              |             |
|------------------------------|-------------|
| AUTHORS - - - - -            | 2, 112, 204 |
| CORRIGENDUM - - - - -        | 207         |
| BOOK REVIEWS - - - - -       | 108, 299    |
| VOLUME 14 INDEXES - - - - -  | 303         |
| VOLUME 14 CONTENTS - - - - - | iii         |